

# **Placement and management of vascular access catheters**

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# Overview

- **Significance and magnitude of complications**
- **Technical aspects of placement**
- **Preventative strategies**
- **Practical cases**

# General

- **20 million patient's receive vascular catheters per year**
- **3 million central venous catheters/yr**
- **Catheter associated sepsis  
frequency: 4-14% estimated 120,000  
cases of line sepsis/yr**
- **Line sepsis increases mortality,  
morbidity and duration of  
hospitalization**

# **Complications of central venous catheters**

- **Placement**

- Hemorrhage, hematoma, hemothorax
- Pneumothorax
- Air embolism
- Cardiac dysrhythmia
- Arterial puncture
- Nerve injury
- Thrombus dislodgment
- Pericardial tamponade
- IVC filter entanglement
- Chylothorax
- Interstitial, mediastinal or intrapleural position

# **General insertion recommendations**

- **Larger prep is better, more prep is better**
- **Full sterile garb please**
- **Full sterile drape**
- **Be comfortable- eat and empty bladder, if time permits**
- **Position the bed for maximal efficiency and comfort**
- **Don't even think about sticking that patient till you're sure about the anatomy**

# **General insertion recommendations continued**

- **The wire will touch any exposed non-sterile surfaces**
- **Terminate the procedure if sterility is violated**
- **Communicate with the patient, reassurance is the best anxiolytic,**
- **Be liberal with lidocaine, anxiolytics if ventilated.**
- **Move to another site if no success with 3-5 passes**
- **10cm of wire in the vessel is plenty. Avoid passing the wire into the heart**
- **If the wire doesn't pass, the needle and wire should be removed together, or risk shearing or unraveling the wire.**

# Internal Jugular Vein

## **– Pros**

- **Compressible**
- **Facilitates PA catheter placement**

## **– Cons**

- **Risk of pneumothorax**
- **Carotid artery puncture**
- **Challenging landmarks in the obese**
- **Often not accessible, C-collars, trach**
- **Possible increased infection risk (pulmonary secretions)**
- **Left sided IJ - increased risk of PTX and thoracic duct injury**

# Internal Jugular Vein

- **Positioning**

- Trendelenberg position
- Head rotated contralateral to insertion site

- **Preparation**

- Liberal use of prep - iodine or chlorhexidine, in circular pattern - encompass angle of jaw, suprasternal notch
- Allow prep to dry before insertion
- Consider prepping ipsilateral subclavian at same time.

- **Tips**

- This is a superficial vessel, should easily be found with finder needle. There is NEVER a need to hub the large needle!!



# Subclavian Vein

## – Pros:

- Reliable landmarks and position
- ACLS - placement does not interfere with airway management
- When fresh tracheostomy or c-collar in place
- Possible lower infection risk?

## – Cons:

- Noncompressible - avoid in coagulopathy
- Risk of pneumothorax- especially with bullae
- Risk of post-procedure stenosis - problematic in dialysis patients

# Subclavian Vein

- **Positioning**

- Trendelenberg 15 degrees or more
- Back roll optional
- Head either midline or deviated to contralateral side
- Displace ipsilateral arm downward, an assistant applying traction can help in difficult cases

- **Tips**

- Rotate the bevel inferiorly before passing the wire
- Needle should always remain parallel to chest, NEVER “dive” under the clavicle, depress the shoulder and chest tissue
- Hit the clavicle, then walk under it

# Femoral Vein

## **– Pros**

- **Ease of placement**
- **Compressible**
- **No risk of pneumothorax**
- **Ideal if Trendelenburg position is not tolerated or contraindicated**

## **– Cons**

- **Increased risk of thrombosis**
- **Possible increased risk of infection**
- **Challenging PA catheter flotation**
- **Potential for retroperitoneal hemorrhage, stay below inguinal ligament!**
- **Decreased patient mobility**

# Femoral Vein

- **Preparation**

- Shaving recommended by most
- Vigorous cleaning/scrub site

- **Positioning**

- Reverse trendelenberg
- Assistant applying pannus traction
- External rotation of leg optional

- **Tips:**

- Push hard to find the pulse
- Ask...Does this patient have a IVC filter?

# Arterial line placement

- Radial artery
  - Femoral artery
  - Dorsalis pedis artery
  - Axillary artery
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- Note - the brachial artery is an end artery - cannulation can lead to arm ischemia and should be avoided.

# **Arterial line placement**

## **Indications**

- **Hemodynamic monitoring**
  - titration of vasopressors
  - management of hypertensive emergencies
  - BP confirmation when unreliable noninvasive readings
  - monitoring when hemodynamic instability is likely
- **Frequent arterial blood gas sampling**

# Line Sepsis

- **The dreaded complication of central venous access.**
- **What are the risk factors?**
- **How can we reduce the risk?**

# **Catheter colonization, mechanisms**

- **Skin insertion site - most common**
- **Hub colonization**
- **Hematogenous seeding**
- **Contaminated infusate**



# **Prevention of line sepsis**

- **Must prevent colonization at one of three points**
  - **time of insertion**
  - **post insertion skin flora changes**
  - **post insertion utilization of catheter**

# Insertion precautions

- **How important is aseptic technique?**

- **Maximal sterile technique - four fold reduction in PA catheter infection and introducer colonization**

*McCormick, abstract Am Soc for Microbiology 1989*

- **Skin preparation - chlorhexidine possibly superior to povidone-iodine.**

*Maki, Lancet 1991*

- **Infusion therapy teams for insertion and management - can reduce risk of line sepsis 5-8X**

*Faubion, JPEN 1986*

- **Value of protective isolation in ICU**

- **Pediatric ICU**

- Children randomized to: health care provider use of gloves, and gowns during care vs standard practices

- **Results:**

- reduction in nosocomial infection 2 vs 12 p.01
    - interval to first infection - 20 vs 8 days p=.04
    - time to colonization 12 vs 7 days p=.01
    - daily infection rate 2.2 times lower p=.007
    - days febrile 13% vs 21% p=.001

# **Risk of catheter infection**

- **Daily risk of infection**
  - **Peripheral iv: 1.3%/day**
  - **Peripheral arterial catheter: 1.9%/day**
  - **Central venous catheter: 3.3%/day**
- **Risk of infection per day appears to be more linear than logarithmic**

# Risk Factors for infection

- Prolonged catheterization
- Frequent manipulation
- Transparent plastic dressings
- Contaminated skin solutions
- Improper aseptic techniques
- Catheter material
- Number of catheter lumens
- Location of catheter
- **Host factors**
  - antibiotic therapy
  - corticosteroid therapy
  - Illness severity
  - immunosuppression

# Protective factors

Insertion/maintenance by infusion team

Maximal aseptic technique

Topical disinfectants and antibiotics

silver impregnated cuff

antibiotic impregnated catheters

# Skin Care

- **Povidone-iodine gel does not prevent line infections**
- **Entry site abx's decrease bacterial line sepsis, but increase fungal line sepsis, ex. Bacitracin, bactroban etc.**
- **Plastic dressings may increase infection risk by enhancing bacterial growth**
- **Skin flora and density of organisms predicts risk for line infection**



# Frequency of Line changes

- **Data is equivocal however most recent data recommend clinical judgement over scheduled catheter change**
- **The “right” answer may depend on each institution’s experience with line change policy**
- **Risk of technical complications from line replacement has to be balanced with risk of line infection**

# Guide-wire Changes

- **Guide-wire exchanges- no randomized prospective data supporting efficacy in reducing line sepsis**
- **Guide-wire changes probably do not increase infection risk, and do carry less risk of procedural complications than new line placement**
- **Sheep model suggested showering of bacteria with guide-wire change and cross contamination of the new line**

# Reference

- **Guideline for Prevention of Intravascular Device-Related Infections. Am J Infect Control 1996;24:262-293**